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THE THEORY OF "COMPREHENSION" IN THE  
PHILOSOPHY OF MICHAEL POLANYI

by

Richard W. Zipfel, S. J.

A Paper Submitted in Partial Fulfillment  
of the Requirements for the Master's  
Degree in Philosophy

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## VITA AUCTORIS

The author, Richard W. Zipfel, S. J., was born on July 19, 1939 in Cincinnati, Ohio. Baptized in the Roman Catholic Church, he was a member of St. Clare Parish in Cincinnati for the first eighteen years of his life. His grammar school education was divided among three different institutions: College Hill Public School, Mother of Mercy Academy, and St. Clare Parish School. After graduating from grammar school in 1953, he enrolled in St. Xavier High School, a College Preparatory School run by the Jesuits. He completed four years at this high school and graduated in the class of '57.

In the fall of 1957 the author entered the Society of Jesus and began a two year novitiate training program at Milford, Ohio. After taking vows in September of 1959, he began two years of classical studies at Milford College an affiliate of Xavier University. In 1961 he transferred to West Baden College, West Baden Springs, Indiana and began three years of study in philosophy. Since West Baden College is affiliated with Loyola University in Chicago, he received his Bachelor of Arts Degree in Latin from Loyola University in 1961. In 1962

he began working for his Master's Degree in Philosophy.

After completing his three years of philosophical studies at West Baden in 1964, he began a three year period of teaching, which is part of the training program for the Society of Jesus. He is currently residing at St. Ignatius High School in Chicago where he teaches English.

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## INTRODUCTION

Michael Polanyi was born in Budapest, March 12, 1891. His education took place in Budapest and later in Berlin, where he remained from 1923 until 1933 as a member of the Kaiser Wilhelm Institute for Physical Chemistry. In 1933 he was made Professor of Physical Chemistry at Victoria University, Manchester. His interests gradually widened to include Social Studies and Philosophy, and in 1948 he was made Professor of Social Studies at Manchester. As Gifford Lecturer at Aberdeen, 1951-1952, he developed thoughts which seven years later were to emerge in his central philosophical work, Personal Knowledge.

Polanyi has been influenced by Bergson and Dilthey, and by Existentialism in general. The American Pragmatists, and especially Dewey, have also had an obvious effect on him. The influence of the theories of Gestalt Psychology are evident in his work. Finally, his analysis of themes such as knowledge and freedom draw to a large extent on his long experience as a physical scientist and a member of the scientific community.

The main thesis of Personal Knowledge and the central theme running through much of his philosophical writing is the need for

a more adequate, post-critical theory of knowledge. While science and the critical movement have brought with them accomplishments of tremendous value to man, nonetheless, an overemphasis on the critical process combined with an epistemological ideal of strict scientific detachment and objectivity threatens to lead the present age into nihilism, the destruction of all meaning and value. Gradually, religion, morality, art and the social sciences are losing trust and being labeled "unscientific," while the more exact sciences threaten to become the gods of the age. Polanyi would hope that a more adequate theory of knowledge will enable modern man to trust his own abilities to know in a wide range of fields, extending far beyond the limited realms of physical science.

Knowledge, for Polanyi, is essentially an act of "comprehension." It is above all a positive, a-critical activity. The negative, judicial, or critical element in knowledge is of great value but there are limits to its use. If overemphasized it can lead to the destruction of meaning.

The intent of this paper is to examine in some detail Polanyi's idea of "comprehension." The initial chapter explains the structure of comprehension in general. The two succeeding chapters will examine two activities proper to knowledge, name-

ly the use of language and the activity of problem solving, in an effort to see these activities as comprehensive in structure. The fourth chapter will go on to view the fundamentally a-critical nature of comprehension and the limitations of the critical element in knowledge. Finally, the last chapter will examine the appropriateness of this re-evaluation of knowledge in relation to the crisis of the age.



## I. THE STRUCTURE OF COMPREHENSION

"There are many things that a man knows which he cannot put into words." This might be said to be the first principle of Michael Polanyi's theory of knowledge. The phenomenon of ineffable knowledge is as old as man, and Polanyi is far from being the first to take it into account. Artists and men of a creative bent have attached more importance to this intuitive element in knowledge than have the scientifically inclined. But perhaps no other philosopher has been so explicit in making this a central issue in his approach to knowledge. In taking this stance, Polanyi is setting himself over against the Cartesian ideal of "clear and distinct ideas" and equally against the statement of the early Wittgenstein, "Of what cannot be said, thereof one must be silent."<sup>1</sup>

When a man knows something and cannot say it, Polanyi calls this "tacit knowledge." Many people know how to ride a bicycle, yet they could not say exactly how they do it. A student may recognize the difference between a very good teacher and a mediocre teacher. However, if he tries to draw up a list of quali-

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<sup>1</sup>Michael Polanyi, Personal Knowledge (London: Routledge and Kegan Ltd., 1958), 87.

ties which make this man outstanding, the list is not particularly convincing to an outsider. In a similar way, the connoisseur knows his wines and the archeologist knows pottery; yet it is quite another talent for either one of them to be able to spell out verbally what he knows tacitly. A mathematician who is noted for his ability to solve a difficult problem, may be just as remarkable for his clumsiness in trying to explain how he has come upon the particular solution. All these are examples of men who cannot adequately explicitate something, even though they have a tacit knowledge of the matter.

The basic explanation for this anomaly is found in a distinction between two irreducible types of knowing, subsidiary knowledge and focal knowledge. Some things are known by being attended to directly. These are said to be known focally. Other things are known merely as instruments, while attention is focused on a task at hand. This Polanyi calls instrumental or subsidiary knowledge. In writing a letter, one is not attending to the pen in his hand but to the effort of composing a message. Yet, people use the pen correctly. They know what they are doing in using it. The knowledge one has of a pen he is using while writing a letter is subsidiary knowledge, while the knowledge of the idea being expressed is focal knowledge. The distinction

between these two fundamental types of knowledge, can also be expressed in terms of parts and a whole. A person can know the individual parts of a thing without knowing how they go together into a whole. Once the whole is grasped, the parts are seen in a new way, as contributing to the whole. Then the parts are known subsidiarily while the whole is the focus of attention.

These two types of knowledge are irreducible and fundamentally different. When one is attending to a whole and knows its parts only subsidiarily in terms of the whole, he cannot at the same time be knowing the parts directly, as entities in themselves. To emphasize this point, Polanyi casts it in the form of a logical disjunction:

The mutual exclusiveness of the two kinds of knowing can be expressed in terms of a logical disjunction. When we know something by relying on our awareness of it for the purpose of attending to something else (i.e., we know a particular for the purpose of attending to a comprehensive entity to which it contributes), we cannot at the same time not rely on it for this purpose -- as would necessarily be the case if we attended to it exclusively in itself.<sup>1</sup>

It is now possible to explain Polanyi's basic principle more fully. "There are things we know but cannot tell," precisely because there are many things which are known only subsidiarily, in terms of the whole to which they contribute. When a

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<sup>1</sup>Michael Polanyi, "Tacit Knowing," Philosophy Today, 6 (Winter, 1962), 239-262.

student appreciates a great teacher, the student may be unable to make a convincing list of the man's qualities, for the student has known these particulars only subsidiarily. Likewise, the archaeologist may recognize pottery without being able to specify the particulars by which he recognized it, because he knew these particulars only subsidiarily.

This then, for Polanyi, is the structure of all knowledge. Particulars, known subsidiarily, are tacitly integrated around a focus of attention to form a "comprehensive" whole. Thus Polanyi refers to all knowledge as "comprehensive."

### The Body:

The unique nature of the body is the foundation for the structure of knowledge outlined above. A man knows his body almost entirely in a subsidiary manner. Bodily activity involves a complex system of muscular activities, at different levels of consciousness, which are known subsidiarily in terms of the focal purpose of the activity. When someone approaches a friend, he is not focusing upon the smile on his own face, nor the muscular movements involved in extending his hand and moving his legs. All these bodily activities are known subsidiarily, as he focuses upon his going-to-meet-this-person. "Thus our awareness of ourselves in action is related to our objectives, in the same

way as our awareness of the parts of a comprehensive entity is related to our attention fixed on that entity."<sup>1</sup>

The body is unique in that it is not seen as external to the person. He looks out upon the whole external world from his body. An examination of this process of externalizing things other than one's body will show more precisely the subsidiary nature of the body. Polanyi does this in some detail:

Our appreciation of the externality of objects lying outside our body, in contrast to parts of our own body, relies on our subsidiary awareness of processes within our body. Externality is clearly defied only if we can examine an external object deliberately, localizing it clearly in space outside. But when I look at something, I rely for my localization of it in space on a slight difference between the two images thrown on my retina, on the accommodation of the eyes, on the convergence of their axis and the effort of muscular contraction controlling the eye motion, supplemented by impulses received from the labyrinth, which vary according to the position of my head in space. Of all these I become aware only in terms of my localization of the object I am gazing at; and in this sense I may be said to be subsidiarily aware of them.<sup>2</sup>

Bodily existence then, is the foundation of the structure of knowledge. The subsidiary awareness we have of our body is the prime analogate for other examples of subsidiary awareness and makes them possible. Polanyi refers to bodily existence as

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<sup>1</sup>Michael Polanyi, "Clues to an Understanding of Mind and Body," The Scientist Speculates, ed. I.J. Good (London: Heinemann, 1962), 71-78.

<sup>2</sup>Polanyi, Personal Knowledge, 59.

"indwelling." One dwells within his body in knowing and using external things. To speak of dwelling within the body is another way of saying that the body is known subsidiarily in all bodily activities. It is known not as an object but as an instrument of activity. A person pours himself into an instrument or dwells within an instrument to achieve some purpose or objective. In the same way a person dwells within his own body to achieve his bodily purposes and objectives. This notion of indwelling can then be extended to all instances of subsidiary knowledge. When one moves from knowledge of parts in themselves, to the knowledge of them as contributing to a whole, he can be said to "interiorize" or dwell within these particulars in comprehending the whole. "The act of comprehending a whole is an interiorization of its parts, which makes us dwell in them in a way that is logically similar to the way we dwell in our body."<sup>1</sup>

#### Knowledge--practical and theoretical:

It is now possible to briefly scan some different levels of knowledge to see the structure of comprehension at work in them. From the beginning, Polanyi refuses to separate skilful doing

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<sup>1</sup>Michael Polanyi, "Science and Religion: Separate Dimensions or Common Ground?," mimeographed for private circulation only.

(practical knowledge) from theoretical knowing. They complement each other in most areas of knowledge, and they share the similar structure of comprehension.

Skill is a performance, achieved by the observance of a set of rules which are not known as such to the person following them. The swimmer or cyclist has mastered his skill, and in performing it he coordinates a number of muscular and perceptual activities in a very regulated way, without in the least being able to specify the activities or the rules by which he works. Similarly the pianist performs a highly complicated skill. While focusing his attention upon the music, he is only subsidiarily aware of his fingers; yet, he is exercising perfect control over them. If he should change the focus of attention from the music to his fingers, in an attempt to substitute a focal control for subsidiary control, he would make mistakes and his performance would break down. Likewise, the conductor of an orchestra does not concentrate upon the individual movements of his body, but rather on the task at hand. He is only subsidiarily aware of his own movements.

Very often skills are performed with tools. Consider the example of a golfer. He concentrates his attention upon the ball. His whole effort is to hit the ball well. He is only subsidiarily aware of the club in his hands. If he should shift

his attention from the ball to the club he would probably miss the ball entirely. The same dilemma appears in tennis. One must concentrate on hitting the ball cleanly, and let a subsidiary awareness control the racket.

It is obvious that the subsidiary awareness which one has of a tool used in a skilful performance, is very much akin to the awareness of his own body. Of course a tool can be focused upon in itself, but when it is taken precisely as a tool it becomes an extension of the body. A tool can be clearly seen as an extension of the body if one considers how the impacts in the hand can be displaced and felt to take place at the outer reaches of the tool itself:

Think of the use of tools. In hammering in a nail we attend to the hammer as it hits the nail, but we do so of course by being aware of the way the handle of the hammer impinges on our palm. The rower is aware of the strain in his hands and arms only in terms of the blades tearing the water. The blind man groping his way by means of a stick is aware of its impact on his palm in terms of the way the outer end of the stick hits on objects in front of him. When using a probe the surgeon feels the point at which its tip touches the walls of a cavity he is exploring. In all these cases, the thing to which we are attending is situated at some distance from the things on the awareness of which we rely for attending to them...<sup>1</sup>

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<sup>1</sup>Michael Polanyi, "History and Hope: An Analysis of Our Age," Lectures delivered at the Thomas Jefferson Center for Studies in Political Economy, University of Virginia, 1961. Mimeographed for private circulation only, 32-33.



If tools then are assimilated as an extension of the body, one can be said to "interiorize" or "dwell within" a tool while performing a skill. The tool along with the body is known subsidiarily, while attention is focused on the purpose of the skill. This is why the carpenter cannot explicitate all that goes into his skill, nor can the apprentice learn carpentry by reading a book.

The act of perception itself, which is fundamental both in skilful performances and in higher scientific areas, is a comprehensive achievement. The one doing the perceiving, subordinates a number of perceptual clues, known subsidiarily, to a focus. There are many subsidiary particulars which contribute to any act of perception:

...all these things which go on inside our eyes and other parts of our body in the process of seeing an object, and the memories which enter into our seeing from the back of our minds, as well as the remote bits of the visual field from the corner of our eyes, are things on our awareness of which we rely for seeing an object in a particular way. In this sense we undoubtedly know these things but we have little or no knowledge of them in themselves.<sup>1</sup>

Perception and skill are both an important part of science. An expert who can identify 800,000 species of insects, relies on a highly trained power of perception. He obviously knows many

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<sup>1</sup>Michael Polanyi, "Faith and Reason," Journal of Religion, 41 (October, 1961), 237-247.

things subsidiarily which he could not explicitate. He could of course explain much, but much would have to remain unsaid. This is why zoology and botany cannot simply be learned from books, any more than medicine. Many hours of practical laboratory work, under a teacher, must be given to these and other branches of the natural sciences. Skill in perceiving and testing must be acquired, and a person must become aware of a multitude of clues and particulars that cannot be exhaustively identified:

...testing has itself to be learned along with the art of recognizing the physiognomies of the tested objects. We must jointly learn to be skilful testers as well as expert knowers. Actually these are only two different and inseparable processes of comprehension. Expert knowing relies on a comprehension of clues, while skilful examination relies on a combination of dexterous motions for tracing these clues.<sup>1</sup>

Besides skill and perception, there is a purely theoretical aspect of knowledge which might not at first seem to share the structure of comprehension. Theoretical science involves working with a symbolic system of some type, whether mathematical or linguistic. Polanyi contends that man's use of a symbolic system has the same structure as the other levels of knowledge explored thus far. A word or mathematical symbol or musical notation can be observed in itself, as a mark on paper

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<sup>1</sup>Michael Polanyi, "The Terry Lectures," Yale University, 1962. Mimeographed for private circulation with additions. Lecture I, 14.

or a sound in the air, an entity of its own. However, to observe it in this way is to make it linguistically or mathematically or musically meaningless. This destruction of meaning is similar to the confusion which arises if the pianist focuses upon the movement of his hands or if the carpenter focuses upon the hammer in his hand. One does not "observe" a symbolic statement, one "reads" it. To read he must assimilate the symbolic notation subsidiarily, interiorizing it and dwelling within it, in an effort to "comprehend" its meaning. Attention is focused on meaning while individual symbols are known subsidiarily. Thus a symbolic system or statement resembles a tool in that it can be interiorized and can become an extension of the body. Thus Polanyi says of Scientific theory:

To rely on a theory for understanding nature is to interiorize it. For we are attending from the theory to things seen in its light and are aware of the theory, while thus using it, in terms of the spectacle that it serves to explain. This is why mathematical theory can be learned only by practising its application: Its true knowledge lies in our ability to use it.<sup>1</sup>

Finally, this consideration turns to the level of interpersonal knowledge, which can include all the levels discussed up to this point. Generally, it can be said that one person comes to know another person's mind or intent by observing his actions

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<sup>1</sup>Polanyi, "Terry Lectures," Lecture I, 14.

or through direct communication. The question at issue is whether inter-personal knowledge and communication share the structure of comprehension that has been characteristic of other levels.

Consider the case when one man comes to understand the skilful performance of another man. As he watches the other man, he must try to combine mentally the performances which the other is combining physically. By mentally dwelling within the particulars of the performance, he observes the same pattern which the performer is trying to produce. Two kinds of indwelling meet here. The performer coordinates his moves by dwelling in them physically as parts of his own body, while the observer tries to coordinate them from outside, by interiorizing them and dwelling within them as extensions of his body. By such exploratory indwelling a student or apprentice may learn a master's skill.<sup>1</sup>

In a similar way, chess players may replay games their master played to see what was in his mind. Students read books or study paintings in an effort to read a master's mind. These efforts are efforts at interiorization, efforts to dwell within these particulars in the same way the master dwelt within them in creating them. This analysis can easily be extended to explain direct communication. In listening to another person speak, one

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<sup>1</sup>Ibid. Lecture II, 1-2.

attempts to interiorize the particulars of his speech according to the same focal meaning which the speaker has. The particulars are not just words, but tone and gesture as well. The same combination of words may be susceptible of different meanings, that is different focuses. If the one listening interiorizes the words or any other particulars in a manner different from the interiorization of the speaker he has misunderstood. The interiorization may make perfect sense, but he has failed to understand the mind of the other person. In all these cases of inter-personal knowledge, the particulars are known subsidiarily in terms of a focal meaning. Two acts of comprehension are involved, that of the speaker and that of the listener.<sup>1</sup>

### Analysis, Constructive and Destructive:

Mention has been made all along of the unspecifiability of subsidiarily known particulars. It is now time to look more closely at this phenomenon and to examine its implications in the area of analysis. Analysis has always been a favorite method for improvement of skills and knowledge at all levels. A young boy asks his father to point out flaws in his batting stance, and

<sup>1</sup>The "intuitive" element in all levels of knowledge, especially noticeable on the inter-personal level, is explained by the unspecifiability of subsidiary knowing, which is involved to a greater or lesser extent in all comprehension.

tries to correct them by concentrating attention on individual points such as his feet or hands or the angle of his bat. An aspiring young actor spends hours practising his gestures before a mirror. A coach will take movies to try to discover and correct individual flaws in his team's performance. A student of poetry tries to enhance appreciation and understanding by a careful verse-by-verse and word-by-word dissection of the text. A linguist attempts to narrow in on the meaning of words by compiling long lists of various types of usage.. A scientist checks and re-checks the smallest details of his experiments. And the list goes on. Every area of knowledge uses analysis as part of its methodology.

The basic difficulty that analysis faces is in trying to transform a subsidiary knowledge of particulars and a tacit integration of them into a focal and explicit knowledge. Since subsidiarily-known particulars exist at different levels of consciousness, some, although subsidiary, are rather easily discernible while others are impossible to specify. Even those particulars that are discernible may have their meaning destroyed or distorted by focusing upon them in analysis:

Usually it is not impossible to identify some particulars of a comprehensive entity, for example some symptoms of a clinically diagnosed disease. But in such cases another limitation of specifiability becomes apparent, as Gestalt-

psychology has amply taught us. Specifiability remains incomplete in two ways. First, there is always a residue of particulars left unspecified; and second, even when particulars can be identified, isolation changes their appearance to some extent.<sup>1</sup>

Consider the example of language. Language grows up in a context of use. Through analysis and explicitation correct usage is spelled out in definitions and grammatical rules. However definition is never complete and grammatical rules are subject to further and further qualification. Such an analysis is a specifying of particulars which are subsidiarily known in usage. Usage also knows much more of language that cannot be specified. Definitions and grammar are only helpful to the person who knows the language. They can help him develop his knowledge; but they can never replace the subsidiary knowing of an infinity of particulars and the tacit integration of them that takes place in daily usage.<sup>2</sup>

Polanyi sees growth in knowledge as a dual movement, from comprehension to a specification of particulars in analysis and then reintegration into a comprehensive knowledge of the whole:

As a rule the two kinds of knowing do not completely extinguish each other. We may successfully analyze the symptoms of a disease and concentrate our attention on

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<sup>1</sup>Michael Polanyi, "Knowing and Being," Mind, vol. LXX, No. 280 (October, 1961), 458-470.

<sup>2</sup>Polanyi's theory of language will be explained more fully in Chapter II.

its several particulars, and then we may return to our conception of its general appearance by becoming once more subsidiarily aware of these particulars as contributing to the total picture of the disease. Indeed, such an oscillation of detailing and integrating is the royal road for deepening our understanding of any comprehensive entity.<sup>1</sup>

The first part of this dual movement, analysis, is open to grave risks. An unbridled lucidity can destroy understanding of complex matters. In biological sciences one can lose sight of a pattern or physiognomy by examining its parts under great magnification.<sup>2</sup> In other cases particularization can be irremediably damaging. Meticulous detailing can obscure subjects like history, literature, or philosophy beyond recall.<sup>3</sup> Even when analysis is done properly and leads to deeper understanding, it must be re-integrated into a comprehension of the whole if it is to be fruitful.

Thus the end is similar to the beginning. The fundamental structure of knowledge is comprehension. Even valid analysis leads back to comprehension, where particulars are known subsidiarily and integrated tacitly in terms of a focal meaning. Therefore, it is possible to restate the principle with which

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<sup>1</sup>Polanyi, "Faith and Reason," 239-240.

<sup>2</sup>Polanyi, "Terry Lectures," Lecture I, 15.

<sup>3</sup>Ibid. 15-16.



this chapter was begun, now with deeper understanding through analysis, "there are many things which men know but cannot put into words."

## II. LANGUAGE

The vast superiority of human knowledge over animal intelligence lies in man's ability to invent and use symbolic systems such as language.<sup>1</sup> The universe is known through comprehension, in which particulars are interiorized and tacitly integrated in terms of a focal meaning. Man dwells within these particulars, as extensions of his own body, in comprehending their joint meaning. However, a man cannot assimilate a mountain as part of his mental life. A mountain is unmanageable. In a similar way man cannot interiorize "redness" as part of his mental life, for redness cannot be gotten hold of. There are red books and red drapes, but redness itself cannot be isolated and in that sense it is unmanageable. However, if a mountain and redness are themselves unmanageable, the words "mountain" and "redness" are easily interiorized and used as for comprehending the universe. Through the use of words, man is enabled to understand a reality which would otherwise be unmanageable.<sup>2</sup> Thus language is the tool by

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<sup>1</sup>Michael Polanyi, Personal Knowledge (London, 1958), pp. 68-70.

<sup>2</sup>Michael Polanyi, "Words, Conceptions and Science," The Twentieth Century, September, 1955, p. 259.

which man comprehends the universe; and by examining language in some detail it will be possible to see comprehension at work.

The previous chapter examined the phenomenon of a man who could not say all that he understood. This chapter will take as its starting point the opposite phenomenon of one who cannot understand all that he has said. A child will easily fall into verbal puzzlement over a matter which he is quite capable of handling in practice. In this case, the child has become involved in a linguistic fumbling which will later be corrected by fuller understanding. There is as well the case of the mathematician working out mathematical conclusions which will later prove to have relevance and fruitfulness in the field of science. However, this scientific relevance and fruitfulness are, for the time being, hidden from him. Here the mathematician is involved in a linguistic pioneering which will be followed up by full understanding. Both instances, that of the child and that of the mathematician, point up the power of language to lead a man beyond his present ability to understand all that he is saying.

The phenomenon of a man unable to understand all that he has said, brings out clearly the two fundamental aspects of language: 1) language as a formalized system, and 2) language as a tool for interpreting reality. As a formalized system it can

lead a man to conclusions beyond his present ability to understand. Since it is also a tool for interpreting reality man faces the question as to whether his conclusions are a true revelation of reality or more sophistry.<sup>1</sup>

Corresponding to the two aspects of language, Polanyi distinguishes two types of meaning -- existential meaning and denotative meaning. The more obvious kind of meaning is denotative in which one thing (a word) means another thing (an object). Other things like a tune or a pattern are more problematic, for while they are not meaningless, they have a meaning only in themselves. They do not stand for something else. This second type of meaning Polanyi calls existential.

We may describe the kind of meaning which a context possesses in itself as existential, to distinguish it especially from denotative or more generally, representative meaning. In this sense pure mathematics has an existential meaning, while a mathematical theory in physics has a denotative meaning. The meaning of music is mainly existential, that of a portrait more or less representative, and so on. All kinds of order, whether contrived or natural, have existential meaning; but contrived order usually also conveys a message.<sup>2</sup>

Language, of course, has both kinds of meaning. As a formalized system it has existential meaning; while, as a denotative tool

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<sup>1</sup>Personal Knowledge, pp. 94-95.

<sup>2</sup>Polanyi, Personal Knowledge, p. 58.

for interpreting reality it has denotative meaning. This dual quality of language is of prime importance to Polanyi; therefore, this essay will treat each of these aspects in some detail.

### Language, a Formalized System:

Language is not created over night. Rather, it is the result of an intelligent effort over a long period of time. It arises within a culture, from the attempt of individuals to communicate with one another. It acquires richness as the people grow in depth of feeling and thought. It becomes refined and precise as the culture becomes sophisticated. Words gather meaning the way a floor gathers dirt, through continued use by many different people over a long period of time. Some words are used by only a small number of people in very special circumstances, while others are used by all the members of the culture. Some words prove useful for a time and eventually die out, while others are preserved for centuries. Words are combined in certain patterns. With time these patterns become somewhat regulated and are more or less precise. New patterns are added, some vanish, others remain. When a certain level of culture is reached, dictionaries are written in an attempt to put down on paper the meanings that words have acquired. Grammars are written, explicating the patterns of use in terms of linguistic rules. However,

dictionaries and grammars become out-dated as usage changes; and inevitably new dictionaries and new grammars appear. And the process goes on in an unending stream.

The evolution of language is slow and almost imperceptible. At a given moment in a culture's development, its language forms a systematic whole, fairly well defined by current dictionaries and grammars. The words and patterns of the language embody an interpretation of reality which incorporates the beliefs, the insights, and the values of earlier generations.

Different languages are alternative conclusions arrived at by the secular gropings of different groups of people at different periods of history. They sustain alternative conceptual frameworks, interpreting all things that can be talked about in terms of somewhat different allegedly recurrent features. The confident use of the nouns, verbs, adjectives and adverbs, invented and endowed with meaning by a particular sequence of groping generations, expresses their particular theory of the nature of things.<sup>1</sup>

A child, growing up in a culture and learning to speak its language, takes on the way of thinking and the vision of reality which the language embodies. He gradually interiorizes it and dwells within it as an extension of his body. The language forms a framework through which he views the world. This framework breaks the world into various elements. The patterns of the language provide him with rules for reorganizing words, and

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<sup>1</sup>Polanyi, "Words, Conceptions, and Science," p. 266.

thereby reorganizing the elements of the world, into new and different combinations.

In its strict form, the conceptual reorganization of words according to logical patterns is known as deduction. This conceptual reorganization takes language as a formalized system rather than a tool for interpreting reality. As one progresses away from ordinary language into more and more precise symbolic systems, there arises a greater and greater emphasis on the formal and systematic elements over the applicability of the system to experience.

(1) the descriptive sciences, (2) the exact sciences, (3) the deductive sciences. It is a sequence of increasing formalization and symbolic manipulation, combined with decreasing contact with experience. Higher degrees of formalization make the statements of a science more precise, its inferences more impersonal...; but every step towards this ideal is achieved by a progressive sacrifice of content. The immense wealth of living shapes governed by the descriptive sciences is narrowed down to bare pointer-readings for the purpose of the exact sciences, and experience vanishes altogether from our direct sight as we pass on to pure mathematics.<sup>1</sup>

Pure mathematics then is almost totally a formalized system. The symbols of pure mathematics, like chessmen, do not necessarily stand for anything denoted by them in experience. Primarily, they stand for the use that can be made of them,

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<sup>1</sup>Polanyi, Personal Knowledge, p. 86.

according to known rules. The mathematical symbol embodies the conception of its possible operations, just as a piece in chess embodies the conception of the moves which it may make. Thus pure mathematics lies almost entirely in the category of existential meaning as opposed to denotative meaning.

The surprisingly varied terms in which systems of algebra or geometry can be interpreted, demonstrate the tenuousness of their denotative functions. They do not refer to particular things and may be altogether empty categories, well defined, but applying to nothing. ....These self-contained systems of pure mathematics may tell us something which is important, without primarily referring to anything outside themselves.<sup>1</sup>

It is now appropriate to ask whether the understanding and use of a formalized system involves comprehension. Polanyi would claim that it does. It is true that a logical deduction in mathematics is a formally articulated set of steps which produces a conclusion totally implied in the premises. Moreover, these steps proceed according to a set of rules which have been at least partially articulated. The truth of the deduction does not depend in any way upon anything which it denotes in experience, but simply on its internal consistency. Nonetheless, the understanding of a logical deduction has an informal, tacit and subsidiary element and must be comprehended as a meaningful whole.

To begin with, mathematical symbols, though they do not de-

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<sup>1</sup>Ibid.



note anything in experience, must still be interiorized and known subsidiarily. To look at a mathematical symbol in itself, as a mark on paper, renders it meaningless. The meaning it has within mathematics, and therefore within any given deduction, must be known focally and comprehensively, while the symbol itself is known subsidiarily.

Not only is the understanding of the meaning of mathematical symbols a comprehensive achievement; but more important, the grasping of a mathematical deduction is itself an act of comprehension, and thus tacit in character. A mathematical deduction may be articulated, but unless the proof is understood the articulation is worthless. Certainly, no teacher would be satisfied with giving his students a chain of formulae connected by formal operations, and a student has not gained anything by learning such sequences by rote. Unless the student has interiorized the articulated proof and grasped it as a comprehensive whole, he has not understood the deduction.

To look at a mathematical proof by merely verifying each consecutive step -- says Poincare -- is like watching a game of chess, noting only that each step obeys the rules of chess. The least that is required is a grasp of the logical sequence as a purposeful procedure: what Poincare describes as "the something which constitutes the unity of the demonstration." It is this "something" -- perhaps in the form of an outline embodying the main steps in the proof -- for which the student will grope, if baffled by a sequence of operations which convey no sense to him, and it

is again this outline, embodying the general principle or general structure of the mathematical proof, which will be remembered when the details of the proof are forgotten.<sup>1</sup>

Thus, the individual articulated steps of a deduction are interiorized subsidiarily, while the main lines of the proof are a succession of tacitly integrated wholes, which are themselves tacitly integrated into the larger whole which is the entire deduction.

The analysis of pure mathematics has pointed up clearly the nature of a formalized system. It is characteristic of a formalized system to have existential meaning, and in a pure state such as mathematics it is devoid of denotative meaning. A formalized system is understood through a tacit and comprehensive grasp of its internal unity and consistency.

When a formalized system is referred to experience an entirely new element is brought in. Now the system is given a denotative reference, over and above its existential meaning. This occurs for instance when mathematics is used in science. An attempt is made to tie mathematical symbolism down to certain elements of experience, and the fruitfulness of such an attempt is abundantly clear in the history of modern science. In language there is an even greater reference to experience. Here one finds an immensely complex integration of these two aspects of

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<sup>1</sup>Polanyi, Personal Knowledge, pp. 118-119.

language often come into conflict, and no easy harmony can be established between them. The reason for this conflict will come clear in the following discussion which takes up the application of the formalized system of language to reality.

### Language, a Tool for Interpreting Reality:

The formalized system of a given language has grown up among a people trying to organize the world in which they live. People have named things and some of the names have remained and grown in meaning. They have come to use words according to certain patterns, and some of the patterns have caught on. Gradually the system was built up, not arbitrarily but by intelligent people trying to understand and express their common experience. At a given moment the system is a formalized whole. But to see it this way is an abstraction. For a system of language is always in process, changing, developing. It has a threefold relation to experience. It relates to the experience of past generations who have formed the language and given it meaning (denotative and existential). It relates to present experience in that the people who use it look upon it as a true interpretation of reality. And, very importantly, it relates to future experience. It promises to fit future experience into its categories and open up fruitful areas for future investigation. This

future reference of a linguistic system Polanyi calls its "power of anticipation."

Moreover, by being prepared to speak in our language on future occasions we anticipate its applicability to future experiences, which we expect to be identifiable in terms of the classes accredited by our language. These expectations form a theory of the universe which we keep testing continuously as we go on talking about things. So long as we feel that our language classifies things well we remain satisfied that it is right and we shall continue to accept the theory of the universe implied in our language as true.<sup>1</sup>

The future reference or power of anticipation which a linguistic system has is not unique. A similar power of anticipation can be found in less articulate activities of animals and men. For instance, perception gradually builds up a habitual way of seeing things, a framework which divides reality into identifiable objects. These perceptual categories not only apply to present experience, they also anticipate being able to structure future perceptions in a similar way. Thus linguistic anticipation is akin to that of lower levels.

The power of our conceptions lies in identifying new instances of certain things that we know. This function of our conceptual framework is akin to that of our perceptive framework, which enables us to see ever new objects as such, and to that of our appetites, which enables us to recognize ever new things as satisfying to them. It appears likewise akin to the power of practical skills, ever keyed up to meet new situations. We may comprise this

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<sup>1</sup>Polanyi, "Words, Conceptions, and Science," p. 258.

whole set of faculties, our conceptions and skills, our perceptual framework and our drives, in one comprehensive power of anticipation.<sup>1</sup>

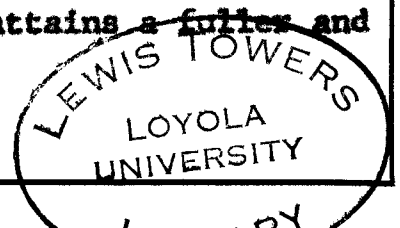
A linguistic system, with its power of anticipation, is not static. It is in process. If it anticipates being able to structure future experience, it does not anticipate doing this without itself being changed in the process. When a language is still young it interprets a narrow range of reality in a rather clumsy fashion. This is satisfactory, for the people using it have not reached a level of sophistication to need a precise language. As a culture's experience widens with time its language changes, takes on new meanings, acquires new words, uses old words more precisely and with greater depth of meaning. This change is continual. Thus a linguistic system in meeting future experience will not simply bring this new experience under its old categories and patterns, but will also adapt its categories and patterns to the newness of the experience. This adaptation and modification of the linguistic system as it meets new experiences takes place on three levels: 1) in the life of the child learning to speak, 2) in science, and 3) in the everyday use of language.

1) The child uses words clumsily. He points at the wash

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<sup>1</sup>Ibid. 259-260.

fluttering in the wind and calls it "weather," and he calls the clothespins "small weather" and the windmill "big weather." This clumsiness in his language reflects a mental confusion over the things he is talking about. His use of language will be corrected simultaneously with his understanding of the difference between weather, wash, windmills and clothespins. This type of groping toward linguistic and mental clarity is not confined to the child. Most men have a comparatively safe knowledge of a certain number of frequently used words. However, this nucleus is surrounded by many half-understood expressions which they seldom use. As long as one does not have to use these words, or can use them in situations which do not bring out the confusion involved, there is no stimulus to seek greater clarity. However, with time, the child who calls the wash "weather," and the man who is forced to use half-understood words, will grope for greater clarity. In attaining this clarity, old and confused conceptions will be replaced by newer and clearer ones. Here, an individual's linguistic system is being modified at the fringes, where half-understood words are replaced by fully understood words. In going through this process, one comes to greater competence in the use of a larger number of words, and at the same time attains a fuller and clearer knowledge of reality.



A culture is much like a child in developing its linguistic system. It begins by naming things rather awkwardly. When confusion results from the use of some of its conceptions, it is forced to find better words to clear up the confusion. This process goes on continually as a culture struggles to understand reality more fully, and from this process emerges a complex and formalized linguistic system which expresses the character of the people and their interpretation of reality.

2) The type of modification of a linguistic system which goes on in science is very similar to the above case of the child, a progression from confusion to clearer understanding through a clarification of terms. However, because of the sophisticated atmosphere in which it takes place, it is more impressive. Polanyi cites the example of the atomic theory of chemistry, established by John Dalton in 1808 and generally accepted almost immediately. For the next fifty years, though all scientists used the theory, its meaning remained obscure:

It came as a revelation to scientists when in 1858 Cannizaro distinguished precisely the three closely related conceptions of atomic weight, molecular weight and equivalent weight (weight per valence), which had been used until then in an indeterminately interchangeable manner. The appositeness of Cannizaro's interpretative framework brought new clarity and coherence into our understanding of chemistry. Such clarification is irreversible; it is as difficult to reconstruct today the confused conceptions which chemists used during the previous half century (and which for example

induced Dalton to reject Avogadro's Law as contrary to the atomic theory of chemistry), as it is to be baffled once more by a puzzle after having discovered its solution.<sup>1</sup>

Here again one observes a very precise and sophisticated linguistic system changing and being modified by the intelligent men who are attempting to mold it into a better and better tool for interpreting reality.

3) Language is constantly being modified in its everyday use, apart from the spur of a particularly acute problem, as it is applied to an ever new and slightly different set of experiences. This type of gradual and imperceptible modification takes place both in ordinary life and in science. Every new occasion on which a word is used is slightly different from any previous occasion. The entire meaning which the word has acquired through past use is brought to bear on this new situation. However, the very newness of the situation demands that the word be slightly modified to fit the situation. "In this changing world, our anticipatory powers have always to deal with a somewhat unprecedented situation, and they can do so in general only by undergoing some measure of adaptation."<sup>2</sup>

The necessity of continually adapting a linguistic system in bringing it to bear on an ever new reality is, of course, prob-

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<sup>1</sup>Polanyi, Personal Knowledge, p. 107.

<sup>2</sup>Polanyi, Personal Knowledge, 110.



lematic. If one applies the word "owl" to an unprecedented owl, what makes this more true than calling the bird a sparrow, and adapting one's linguistic system to include this bird as an example of "sparrow"? In other words, is not the modification of a linguistic system to fit an ever new reality an arbitrary thing?

Polanyi would claim, within limits, that this modification is a matter of truth and error. If a culture modifies its language to fit an ever wider reality more adequately, its language grows into a truer theory of the universe. This can be illustrated in the example of the owl and the sparrow: "Thus we call a new kind of owl an owl, rather than a sparrow, because the modification of the conception of owls by which we include the bird in question as an instance of owls makes sense; while a modification of our conception of sparrows, by which we would include this bird as an instance of sparrows, makes nonsense."<sup>1</sup> The decision to call an unprecedented bird an owl rather than a sparrow is a tacit decision, by which one modifies his language, and a decision which involves truth and error. Because men realize that truth hangs in the balance, they will often argue long and bitterly about the use of words.

Polanyi cites an example of this in science. In 1932 Urey

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<sup>1</sup>Ibid. 111.

discovered heavy hydrogen (deuterium), and described it as a new "isotope" of hydrogen. In 1934, at a discussion held by the Royal Society, Frederic Soddy who had discovered isotopy, objected to Urey's use of the word "isotope." Soddy had originally defined the isotopes of an element as chemically inseparable from each other, and heavy hydrogen was chemically separable from light hydrogen. Soddy's protest was ignored and a new meaning of the term "isotope" was tacitly accepted.

The new meaning allowed heavy hydrogen to be included among the isotopes of hydrogen, in spite of its unprecedented property of being chemically separable from its fellow isotopes. Thus the statement "There exists an element deuterium which is an isotope of hydrogen" was accepted in a sense which re-defined the term isotope, so that this statement, which otherwise would be false, became true. The new conception abandoned a previously accepted criterion of isotopy as superficial, and relied instead only on the identity of nuclear charges in isotopes.<sup>1</sup>

In all three of the above areas a similar phenomenon is at work. Man possesses a formalized system of language, built up over many years, which must serve him as a tool for interpreting reality. In applying this language to an ever new experience, he not only comes to understand this experience, but he also continues to modify his language, changing the system which has been handed to him by past generations and building it into an ever

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<sup>1</sup>Polanyi, Personal Knowledge, p. 111.

more adequate tool for understanding the universe.

Polanyi claims that this adaptation of language is a tacit and subsidiary achievement, which explains its often imperceptible character. As one learns language, he interiorizes its words and patterns and the various meanings and connotations which the idioms of the language can bring about. In a given situation, all these elements, known subsidiarily, are integrated into a unique focal and comprehensive meaning as he tries to make sense of the situation in front of him and put this into words. In the process of making sense of the situation he adapts many of subsidiary elements of his language to include what is new in the present situation. The adaptation itself takes place subsidiarily, and the whole process of understanding the situation and expressing it is a comprehensive achievement.

The adaptation of our conceptions, and of the corresponding use of language to new things that we identify as new variants of known kinds of things, is achieved subsidiarily while our attention is focused on making sense of a situation in front of us. So we do this in the same way in which we keep modifying, subsidiarily, our interpretation of sensory clues merely by striving for clear and coherent perception, or enlarging our skills without focally knowing how, by practising them in ever new situations. The meaning of speech thus keeps changing in the act of groping for words, without our being focally aware of the change, and our gropings invent words in this manner with a fund of unspecifiable connotations. Languages are the product of man's groping for words in the process of making new conceptual decisions, to be conveyed by words.<sup>1</sup>

This treatment of language began with the phenomenon of

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<sup>1</sup>Polanyi, "Words, Conceptions and Science," pp. 265-266.

a man unable to know all that he had said. It was claimed that the phenomenon was due to a verbal speculation which had led the man to conclusions which were linguistically consistent, but whose reference to reality was yet obscure. In the succeeding parts of the treatment, this split between linguistic consistency (existential meaning) and reference to experience (denotative meaning) was analyzed in terms of the dual aspect of language. Language is both a formalized system and a tool for interpreting reality. As a formalized system it has its own internal and existential meaning, and can be used for verbal speculation. As a tool for interpreting reality, the formalized system itself has a denotative reference, and if the denotative reference of a particular verbal speculation is obscure, then the above phenomenon can occur. Also, in applying a linguistic system to reality, the system is constantly modified to interpret an ever new reality more adequately. Finally, comprehension is involved at all levels. Understanding the internal meaning and consistency of a linguistic system is an act of comprehension, understanding the denotative meaning of a linguistic system is an act of comprehension, and modifying the linguistic system to denote reality more precisely is an act of comprehension.

Against the background of this analysis of language as a

comprehensive achievement, Polanyi tackles a perennial problem of philosophy, namely the problem of universals. This chapter will conclude with a discussion of Polanyi's treatment of this topic.

### Universals:

In considering Polanyi's treatment of universals, two main questions suggest themselves: 1) The logical difficulty of uniting a number of things which differ in every respect under a single conception or a single word: 2) The reality or objectivity of the classifications designated by a universal term.

1) Since the days of Plato men have wrestled with seeming contradiction involved in using the word "man" to designate two men who were different in every respect. This problem cannot be discarded by the claim that one unites two different men under a single term by designating some feature or aspect which the two hold in common. For the problem can now be restated in terms of this common aspect. "How can one refer to an aspect as 'common', when he is really uniting under a single term two aspects which differ from one another in every respect. This problem is similar to that of empirical induction, where a single law is used to explain experiences which differ in every respect. Polanyi claims that the difficulty involved here is that men are searching for an explicit procedure for forming classifications of objects

to be designated by a single term. Because universalizing and induction are tacit performances, it is ultimately impossible to obtain such an explicit procedure.

In forming a universal, the individuals which differ from one another, are known subsidiarily and integrated tacitly in terms of their focal meaning. This focal meaning is expressed by a word, which thus becomes a universal term. Thus the formation of a universal is an act of comprehension and involves tacit knowing. The tacit act by which one integrates the different individuals can never be fully explicitated, as is true of all tacit activity. This is why Polanyi denies the possibility of finding an explicit procedure. By his own acknowledgement of tacit knowledge he explains the process of induction and avoids searching for an explicit justification of it.

In forming a universal, one's tacit powers overcome an apparent contradiction. Taking two things which differ in every respect, they integrate them by finding them identical in some other way. Polanyi tries to throw light on this type of integration, by pointing to examples on the level of perception where tacit knowing integrates conflicting clues in various ways.

...there is an important case when conflicting visual clues are integrated to a true sight. We fuse the two different pictures of an object cast on the retina of our eyes by forming its stereoscopic image. Here perception resolves a

contradiction by revealing a joint meaning of conflicting clues in terms of a new quality. A similar synthesis is achieved when we hear a sound as coming from a definite direction by combining its impacts that reach first one ear and then the other. This is also what happens in the formation of a general conception.<sup>1</sup>

However, there is an important difference between the perceptual integration of conflicting clues and the integration of different objects under a general term. The difference lies in the curiously unsubstantial character of the joint meaning in the universalizing process. "Compared with...stereoscopic images, general conceptions are abstract, featureless, the focus in terms of which we are aware of the members of a class appears vague and almost empty."<sup>2</sup>

Polanyi is not too explicit on the significance of this empty, or vague, or abstract quality of the universal. However, he tries to throw some light on the problem, through the example of coming to know a human being. One penetrates gradually to ever deeper levels of reality which are correspondingly less tangible. One first recognizes a man, then discovers what he is doing, then interprets his motives, and finally forms or reforms a conception of his personality. He hints that the vagueness of

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<sup>1</sup>Polanyi, "Tacit Knowing," 252.

<sup>2</sup>Ibid. 253.

a universal concept as opposed to a perceptual integration of conflicting clues is due to a deeper penetration of reality.

"...as we move to a deeper, more comprehensive, understanding of a human being, we tend to pass from more tangible particulars to increasingly intangible entities: to entities which are partly for this reason more real..."<sup>1</sup>

2) Besides the question of integrating different things under a single conception, Polanyi takes up the question of the character of the universal in relation to the class of entities it claims to designate (i.e. in what sense can it claim to designate an objective class of real entities?). Two problems are of interest here: (a) the non-arbitrary character of man's classifying things by general terms; (b) the tacit and changing nature of these classifications.

(a) At first glance, there would seem to be an infinity of different possible ways to classify things. Certainly different cultures have classified things in different ways. Is it not then entirely arbitrary whether one calls all blue birds by one name and all black birds by another, or calls all birds by a single name which can in turn be modified by the adjectives blue or black? Furthermore, does not this arbitrariness extend to all

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<sup>1</sup>Polanyi, "Tacit Knowing," 253.



possible classifications of things?

Polanyi would place himself squarely against such a theory of language. As was pointed out earlier, language is formed by intelligent men striving to construct a true theory of the universe. Different cultures develop different languages, not because choice of language is purely arbitrary, but because different peoples have different tasks, different personalities, different histories, and different geographical settings. If different cultures are to express themselves intelligently in language, the languages will necessarily be different. To suggest that the Anglo-Saxon peoples, with their own history and setting and personality could have just as well developed a Semitic language as the one they actually developed is, for Polanyi, a monstrous affront to the intelligence of man.

On a more particular level, if men went about classifying things arbitrarily, they would produce an infinity of irrelevancies which would completely destroy the possibility of intellectual growth. For instance, it is ordinarily irrelevant to classify words by their first letters unless one is compiling a dictionary or some similar reference list. It is almost entirely irrelevant to classify words according to their second or third letters. Similarly, it would be ridiculous to classify birds by

their number of feathers, even if such a thing were possible. Thus classifications are a matter of truth and error, or life and death.<sup>1</sup>

(b) The above stand puts Polanyi explicitly in the camp of the metaphysicians. However, his ideas on the tacit and changeable character of universal terms shows his leaning toward pragmatist and existentialist attitudes. His position can best be brought out by examining the "three levels of intentions" which he gives to universal terms.

A universal term refers first-of-all to a certain number of easily-identified, common features which are properties of the class of things named. These could be called surface properties. They will be expressed in any definition of the thing classified, and will be known to anyone at all conversant with the class of things in question.

Secondly, the universal term refers to known but not readily specifiable properties which these entities share. Such properties are not completely specifiable because they are known tacitly and subsidiarily at levels of consciousness that are not easily penetrated. If a class has a large range of such tacitly known properties, it will lend itself to deeper and deeper analy-

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<sup>1</sup>Polanyi, Personal Knowledge, 112-114.

sis over long periods of time. "Words of great human significance accumulate through the centuries an unfathomable fund of subsidiarily known connotations, which we can bring partly into focus by reflecting on the use of such words...Hence the fruitfulness of a Socratic enquiry into the meaning of words like 'justice' or 'truth' or 'courage', etc."<sup>1</sup> Thus this second level of intentions explains why one's explicit knowledge of the meaning of a word can grow, as he penetrates further into the particulars which he knows tacitly.

However, since all analysis of tacit knowledge is incomplete, this second level of intentions also reveals the limits of definition. It is often pointed out that definition is an unending process, for one can go on to define the words used in the definition and this process can be repeated to infinity. Polanyi's explanation of the incomplete character of definition is compelling. Words are tools for interpreting reality, their meaning built up through usage. Definition is akin to analyzing the skilful use of a tool:

It is the same as if we studied the motions involved in using a hammer effectively with a view to improving our hammering. For this we must wield a hammer as efficiently as we can, even while watching our motions to discover the best way of hammering. Similarly, we must use the word

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<sup>1</sup>Ibid. 115.

"justice," and use it as correctly and thoughtfully as we can, while watching ourselves doing it, if we want to analyse the conditions under which the word properly applies. We must look intently and discriminatingly through the term "justice" at justice itself, this being the proper use of the term "justice," the use which we want to define.<sup>1</sup>

And just as one can never completely explicitate all the subsidiarily known particulars which contribute to the skill of using a hammer, so it is impossible ever to completely define a word.

The third level of intentions if formed by the indeterminate range of anticipations expressed by designating a class of things. Just as it was earlier noted that a linguistic system anticipates subsuming future experience into its framework, so a universal term anticipates many future manifestations of the class which it designates. However, it was also pointed out above that as a linguistic framework was applied to future experience, the framework itself would be modified. The case of the universal term is again similar, for as more and more experiences are brought under a universal term, the term gathers new meaning and new connotations. Some of these newly observed properties will accrue at the first level of intentions, and will be easily recognized; while others will accrue at the second level and often will be imperceptible.

Thus it becomes evident that a universal term is meant to designate a relevant, objective class of entities. However, with

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<sup>1</sup>Ibid. 116.

time and the newness of experience, these terms gather meaning and change. The meaning which they gather can be penetrated more and more, but can never be exhaustively explicitated. As always with Polanyi, language is a comprehensive whole, where subsidiary particulars are integrated to a focal meaning, and explicit knowledge is complemented by what is known tacitly.

### III. PROBLEM SOLVING

Solving problems and answering questions is a basic activity which shows up time and again in human living and human knowing. The child is perplexed over "where babies come from." The student struggles for the answers to his math. The young husband worries how he will make ends meet. And as he grows older a man may even ponder over the existence of God or the meaning of life. In scientific circles, new problems constantly lead to new discoveries; while the student of science faces the task of discovering for himself what science has discovered through the years. As the first chapter of this work outlined human knowledge as comprehensive in structure, and the second chapter saw that structure at work in language, now the present chapter will attempt to bring out the structure of comprehension in this fundamental activity of solving problems.

All waking animals exhibit a purposive tension, a readiness to see and act and make sense of their situation. The organism constantly strives to adapt itself to its environment and to fulfill the needs it feels within that environment. From this general striving of the organism there emerges the more specific process of solving problems. A person becomes perplexed with an

element of his environment, and this perplexity gives rise to a tension which will remain until the perplexity is resolved. This resolution of the perplexity comes when a new way of perceiving or acting is found which makes sense of the situation and produces satisfaction. Thus the process of solving problems can be divided into four stages: 1) the problem; 2) the heuristic effort moving toward a solution; 3) the moment of discovery; 4) the verification of the discovery.

#### The Problem:

It would be wrong to describe a problem as absence of knowledge, though it is true that a problem implies a certain absence of knowledge. There are myriads of things that a given person is ignorant of, yet not all of these things are a problem for him. Rather, a problem is a stage between ignorance and knowledge. It is a definite addition to knowledge in that the person has selected a certain area of his ignorance and grasped it as a gap in his knowledge. Furthermore, he has found this gap promising and he foresees bridging this gap with a solution to his problem. In fact, seeing a problem involves seeing the first vague outlines of the solution, it involves some conception of the solution. Thus a problem includes a unique balance of the known and the unknown. Polanyi brings out the elements of the known-unknown in

some detail.

Different types of problems will involve more or less clear conceptions of their solutions. The simplest type of problem is searching for an object that is lost. When one looks for his fountain pen he knows exactly what he expects to find, though he does not know exactly where he will find it. He can describe the pen in exact detail and he may well be able to specify a region within which it will be found. In this case the person faced with the problem has a fairly exact knowledge of what he is seeking and how to go about finding it. Searching for a word to fit a crossword puzzle involves a less clear conception. One may know that the word has five letters and is much needed in jungle exploration. These clues in themselves are somewhat vague, and beyond this vagueness it is not certain that the person involved has seen the word before. Moreover, once a suitable word is found it will remain to be seen whether it fits with the rest of the puzzle as the precise word intended. Thus different problems will give rise to different conceptions of their respective solutions, but every problem in some way contains a conception of its solution.

This "pre-conception" of the solution to a problem becomes very important in the progress of science. The scientist cannot take up every problem that occurs to him. If he tried to, science



would soon become cluttered with an infinity of irrelevant details. Instead, he must attempt to assess the relative value of different problems and choose from among them those which will contribute more to the advancement of science. It is only because he has a pre-conception of the solution to the various problems that he can make such value judgments; and these value judgments are a fundamental instance of the scientist's "skill." Choosing a promising scientific problem is an achievement similar to the connoisseur's ability to distinguish good wine from poor wine.

To form such estimates of the approximate feasibility of yet unknown prospective procedures, leading to unknown prospective results, is the day-to-day responsibility of anyone undertaking independent scientific or technical research. On such grounds as these he must even compare a number of different possible suggestions and select from them for attack the most promising problem. Yet I believe that experience shows such a performance to be possible and that it can be relied upon to function with a considerable degree of reliability.<sup>1</sup>

The problem, besides including a pre-conception of its solution, also postulates the existence of that solution. Just as appetites such as hunger postulate the existence of something that will satisfy them, so the intellectual desire that is at work in a problem postulates the existence of a satisfactory solution. Even though the solution is something never before encoun-

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<sup>1</sup>Polanyi, Personal Knowledge, 124.

tered, still it is similar to the mislaid fountain pen which exists. One searches for a solution as if it were there, existing but hidden. Thus comparing real problems with the artificial problems given to students, Polanyi makes the statement: "Problems set to students are of course known to have a solution; but the belief that there exists a hidden solution which we may be able to find, is essential also in envisaging and working at a yet unsolved problem."<sup>1</sup>

The problem then contains both a pre-conception of its solution and a promise of the existence of that anticipated solution. It remains to show how this pre-conception and promise-of-existence fit within the comprehensive structure of the problem.

It was remarked earlier that seeing a problem is a real addition to knowledge. An existing set of facts become a problem when they begin to be seen as pointing to a unity beyond themselves. Up to this point they were seen as isolated facts; now they are no longer isolated facts, but clues which indicate a yet-unknown unification. This switch from being-seen-as-isolated-facts to being-seen-as-clues is a switch from focal to subsidiary knowing. Each of the facts were previously known

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<sup>1</sup>Michael Polanyi, "Problem Solving," The British Journal for the Philosophy of Science, VIII (August, 1957), 97.

focally, as entities in themselves. As they begin to be integrated as subsidiary elements pointing toward a focus, the problem begins to come into view. The integration of course remains incomplete, and the focus remains unknown, until the problem is solved.

This illustrates the most striking powers of tacit knowing, owing to which we can focus our attention on the joint meaning of particulars, even when the focus to which we are attending has no tangible center. It represents our capacity to know a problem. A problem designates a gap within a constellation of clues pointing toward something unknown.<sup>1</sup>

Thus a problem has a comprehensive structure. A set of data begin to be known subsidiarily as clues pointing toward an anticipated focus. The problem posits the existence of a solution by promising a focus in terms of which it will integrate the subsidiary elements. The pre-conception of the solution is the collection of clues. This pre-conception is necessarily vague because the clues are known subsidiarily and the focus remains unknown. Finally, it becomes evident why only the scientist's "skill" can choose the valuable problem from the maze of possible problems. The problem must be assessed in terms of its pre-conception. This pre-conception is a collection of subsidiarily known clues. Therefore, the pre-conception cannot be adequately explicitated

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<sup>1</sup>Polanyi, "Tacit Knowing," 255.

and submitted to close analysis. If the value of the problem is to be assessed, this assessment will necessarily be a tacit and skilful achievement rather than explicit and critical.

### The Heuristic Effort:

Along with a problem comes a tension or a desire to find the solution. This desire leads a man to ponder, to search, to experiment in an effort to obtain a solution. A man faced with a problem may sit down at his desk and take out a pencil and paper. He will write for a while, sit back, pace the floor and after a relatively short period of time the solution will come to him. Another man will live with his problem for weeks or years before hitting upon a solution. At times he will be quite conscious of it and concentrate on trying to find a solution, while at other times it will lie at the very back of his mind, forgotten or nearly forgotten for the moment. The question of interest here is what goes on in the time lapse between the coming of the problem and the finding of the solution. To what extent does the man bring about the solution, and to what extent must he wait for it?

There are two types of problems admitting of two different approaches to solving them, namely the systematic approach and the heuristic approach. Some problems may admit of a systematic solution. If someone knows his pen is somewhere in a given room,

it is possible to search the room inch by inch until it is found. If he literally searches every square inch of the room, he is sure to find the pen. Similarly, it is conceivable to solve a chess problem by trying out all possible moves and counter moves. However, most problems do not in practice admit of such systematic solutions, for the possibilities are far too numerous to permit individual systematic examination.

The heuristic approach to solving a problem (which is of primary interest here) consists of alternating active and passive stages. The person involved begins by setting up the problem as well as he can, then he "waits attentively" for the bright idea. If nothing comes he tries to set the problem in slightly different terms, then waits again. At times he may feel himself approaching near a solution, while at other times he may feel that he has wandered up a blind alley. Thus the person does not set the problem up anew each time at random. Rather he tries to sense when he is moving toward the solution and when he is moving away from it. It is this sense of the approaching solution which enables him to choose, from a myriad of possible ways of setting up the problem, those operations which will lead him to the solution.

I believe that we should...acknowledge our capacity both to sense the accessibility of a hidden inference from given

premisses and to invent transformations of the premisses which increase the accessibility of the hidden inference. We should recognize that this forknowledge biases our guesses in the right direction, so that their probability of hitting the mark, which would otherwise be zero, becomes so high that we can definitely rely on it simply on the grounds of a student's intelligence; or for higher performances, on the grounds of the special gifts possessed by the professional...<sup>1</sup>

Thus the ability to sense the nearness of a solution and to sense the operations that will lead nearer the solution are attributed to the skill of the one attempting to solve the problem. It is similar to the cook's ability to know just what is still needed to make the soup taste perfect.

The active stages of the heuristic effort then consist of operations upon the problem which bring one nearer and nearer to its solution. But what happens during the passive stages, when one "waits attentively"? There is no activity going on in full light of consciousness; however, there may well be activity going on at subconscious levels. Besides this there is a more or less intense concentration upon the problem, a tension and a striving which reaches out for the solution.

Often the solution to a problem will come at the oddest moments. After thinking about it at some length, one may put the problem aside for awhile and take up some other activity.

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<sup>1</sup>Polanyi, "Problem Solving," 99-100.

Often enough it is during such a period of rest that the answer will suddenly come. The only possible explanation for such a phenomenon is that the integrating activity, in some form or other, has continued at sub-conscious levels even after the problem has been put aside.

However, there are passive moments even while one is intensely preoccupied with trying to solve the problem. These are moments of concentration. There are no conscious operations being performed, yet somehow during these moments the solution comes closer, or perhaps leaps into view. Whatever activity takes place, takes place at sub-conscious levels. On the conscious level there is only attention. But attention to what? It must be said that what is attended to in these moments is the solution itself, the unknown answer, the empty focus, the yet-to-be-grasped-integration. These are what a person concentrates on as he waits for the solution.

But what is the object of this intensive preoccupation? Can we concentrate our attention on something we don't know? Yet this is precisely what we are told to do: "look at the unknown!" says Polya, "Look at the end. Remember your aim. Do not lose sight of what is required. Keep in mind what you are working for. Look at the unknown. Look at the conclusion." No advice could be more emphatic.<sup>1</sup>

The heuristic approach to solving problems then is an in-

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<sup>1</sup>Polanyi, "Problem Solving," 98.

telligent (though non-systematic) striving toward an integration of particulars in terms of a yet-unknown focus. The striving is comprehensive in structure in that it is a striving for comprehension. It is an effort to grasp the particulars subsidiarily rather than focally, to grasp them not as facts but as clues to the desired insight. The more successful one is in grasping these particulars as clues the more they will point him toward the solution. There are moments of subconscious activity because there are moments when all activity is at a subsidiary level far below the point of focus. Furthermore, the ability to sense the nearness of a solution and to invent operations which will bring the solution nearer is a matter of "skill," for it deals with subsidiary elements many of which cannot be singled out explicitly. Finally, the center of concentration is the yet-unknown focus of integration, for in concentrating on this empty focus one is able to grasp the various particulars subsidiarily as clues to insight which is yet to come.

...even though we have never met the solution we have a conception of it in the same sense as we have a conception of a forgotten name. By directing our attention on a focus in which we are subsidiarily aware of all the particulars that remind us of the forgotten name, we form a conception of it; and likewise, by fixing our attention on a focus in which we are subsidiarily aware of the data by which the solution of a problem is determined, we form a conception of this solution. The admonition to look at the unknown really means that we should look at the known



data, not, however, in themselves, but as clues to the unknown: as pointers to it and parts of it. We should make every effort to feel our way to an understanding of the manner in which these known particulars hang together both mutually and with the unknown. Thus we make sure that the unknown is really there, essentially determined by what is known about it, and able to satisfy all the demands made on it by the problem.<sup>1</sup>

### Discovery:

A problem is seen. A heuristic effort is begun. Then sooner or later, expected or unexpected, discovery comes. There is the joyful release from the tension which accompanied the problem. Understanding has replaced puzzlement, and the mind has achieved a new vision of reality. What precisely is the nature of this moment of discovery? How does this act of the mind differ from others?

Once a person has solved a problem, he will never again be puzzled by it in the same way. Faced with the same or similar circumstances he will easily grasp their meaning. There will be no problem, no tension, no heuristic effort, no agonized waiting, no joy of discovery in understanding the circumstances involved. In this sense discovery is quite different from any systematic activity, such as adding a column of figures or tabulating items on a grocery counter. Such systematic activi-

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<sup>1</sup>Ibid.

ties can be performed deliberately according to an explicit set of rules. The second and third performances of a systematic activity are not significantly different from the first. They require the same amount of effort, the same concentration, the same time, and they produce the same results and the same minor satisfaction. In this sense Polanyi speaks of systematic activity as reversible and discovery as irreversible. A systematic activity can be traced back to its beginnings and performed again, and there is no significant difference in the acts performed. Discovery cannot be traced back to its beginnings, for it began in puzzlement which cannot be reproduced, and it proceeded by an un-specifiable heuristic effort, not by systematic steps which can be reproduced at will.

This irreversible character of heuristic acts is important. It suggests that no solution of a problem can be accredited as a discovery if it is achieved by a procedure following definite rules. For such a procedure would be reversible in the sense that it could be traced back stepwise to its beginning and repeated once more any number of times, like any arithmetical computation. Accordingly, any strictly formalized procedure would also be excluded as a means of achieving discovery.<sup>1</sup>

Discovery is unique among mental activities in that it involves the attainment of a new view of reality, or at least a new view of some aspect of reality. The new idea is one which was in

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<sup>1</sup>Ibid. 92-93.

no way implied in previously known ideas. Thus Polanyi speaks of discovery as crossing a "logical gap." The logic of the old way of looking at things was incapable of arriving at the discovery. Rather the discovery brings with it a new way of looking at things, with its own logic.

Established rules of inference offer public paths for drawing intelligent conclusions from existing knowledge. The pioneer mind which reaches its own distinctive conclusions by crossing a logical gap deviates from the commonly accepted process of reasoning, to achieve surprising results. Such an act is original in the sense of making a new start, and the capacity for initiating it is the gift of originality, a gift possessed by a small minority.<sup>1</sup>

The bridging of a logical gap comes out clearly in the discovery of an inventor. An invention is not simply something new. There are new cars and new models of appliances coming out each year. They are slightly different, perhaps significantly different from old models; but they are not inventions, for they do not represent an entirely new idea, a new way of thinking which was not implied in the old way of thinking. An invention is something new and original. The inventor has achieved something that could not have been predicted. It is a creation of his intelligence. Therefore, it belongs to him in a special way. A new model of a car is an improvement on older models, but it is

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<sup>1</sup>Polanyi, Personal Knowledge, 123.

not entirely the product of the designer's intelligence in the sense that an invention is. When the law recognizes that something is an invention, that an individual has produced this thing himself, it considers the invention as belonging to that individual and recognizes this ownership in the form of a patent.

The width of the logical gap crossed by an inventor is subject to legal assessment. Courts of law are called upon to decide whether the ingenuity displayed in a suggested technical improvement is high enough to warrant its legal recognition as an invention, or is merely a routine improvement, achieved by the application of known rules of the art. The invention must be acknowledged to be unpredictable, a quality which is assessed by the intensity of the surprise it might reasonably have aroused. This unexpectedness corresponds precisely to the presence of a logical gap between the antecedent knowledge from which the inventor started and the consequent discovery at which he arrived.<sup>1</sup>

Great discoveries are the work of genius and ordinary discoveries are the work of intelligent men, but there are minor acts of discovery scattered all through the every-day life of ordinary people. Facing new situations and new problems, and adapting one's language to meet these new situations, are examples of such day-to-day discoveries: "Admittedly, there are minor heuristic acts within the power of ordinary intelligence and indeed continuous with the adaptive capacities of life down to its lowest levels. The interpretative framework of the

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<sup>1</sup>Ibid.

educated mind is ever ready to meet somewhat novel experiences and to deal with them in a somewhat novel manner."<sup>1</sup>

It remains to see discovery within the structure of comprehension. In the problem stage a number of elements began to be grasped subsidiarily as clues to a yet-unknown. The heuristic effort brought a gradual approach toward the solution, by integrating these elements more and more toward a still-empty focus. Finally, in the moment of discovery, the integration is completed and the focus leaps into view for the first time. With this new integration a logical gap is crossed and a new vision of reality is achieved. The precise nature of the logical gap can perhaps be seen in the difference between subsidiary and focal knowledge. The various elements were known individually and focally prior to the rise of the problem. This focal knowledge of the individual elements could never have led systematically or logically to their integration as subsidiary elements of a new and original focus. Only the heuristic effort and the act of discovery, a tacit and original achievement of intelligence, could cross such a logical gap, integrate the elements subsidiarily to a new focal understanding, and thus attain a new view of reality.

Verification:

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<sup>1</sup>Polanyi, "Problem Solving," 93-94.

The discovery emerges from the heuristic effort accompanied by the conviction that it is true. The problem itself, as was seen earlier, posited the existence of a solution and brought with it a pre-conception of that solution. During the heuristic effort the solution was brought closer and closer. Now, as that solution emerges, it emerges as an existing and true solution to the problem: "Therefore, as it emerges in response to our search for something we believe to be there, discovery, or supposed discovery, will always come to us with the conviction of its being true. It arrives accredited in advance by the heuristic craving which evoked it."<sup>1</sup>

Thus the solution does not emerge in discovery as one possible hypothesis, one among a myriad of possibilities. Rather it emerges from the elements that were in-need-of-explanation and it emerges as the explanation of those elements. It comes as satisfying and as deserving acceptance, and the person who experiences the discovery receives it as something to which he is committed. Thus something similar to verification has already begun in seeing the problem, in the heuristic effort, and in the discovery. Strict verification will carry this process further, but it is not essentially different in nature from the processes

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<sup>1</sup>Ibid. 101.

which have been going on. It is basically rooted in the same "skill" which founds the ability to see a problem, sense the approach of a solution, and come up with a discovery. Similarly, because it is rooted in skill verification will be characterized by an element of unspecifiability and will be ultimately a tacit activity.

Verification attempts to assess the bearing of a theory on experience. The more one finds his theory applicable to and capable of explaining experience, the more he becomes convinced of its truth. However, the bearing of a theory on reality is only partially specifiable. Much of the testing of a theory will be accomplished tacitly and subsidiarily, for many of the elements on which the theory bears can only be known subsidiarily. Verification will attempt to explicitate as many of these elements as possible, and then will go on to explicitate the theory's relation to these elements. However, there are limits to the possibilities of this explicit verification. Those elements which remain subsidiary, which have been tacitly integrated in terms of the theory as their focus, and which cannot be adequately explicitated, these have a claim to truth, and thus to "verity," because they have been satisfactorily integrated by the skilful activity of intelligence. Thus verification is in-

complete, and is rooted in a skilful and tacit activity which claims validity because it satisfies its own built in standards. A theory is "verified," but the skill in which it is rooted is only "validated" by continual satisfactory performance.

In different areas of knowledge, there will be different combinations of verification and validation. Verification is most proper to strict science; while areas such as art, interpersonal knowledge, and religion must be to a large extent validated.

The acceptance of different kinds of articulate systems as mental dwelling places is arrived at by a process of gradual appreciation, and all these acceptances depend to some extent on the content of relevant experiences; but the bearing of natural science on facts of experience is much more specific than that of mathematics, religion or the various arts. It is justifiable, therefore, to speak of the verification of science by experience in a sense which would not apply to other articulate systems. The process by which other systems than science are tested and finally accepted may be called, by contrast, a process of validation.<sup>1</sup>

But everywhere, even in the strictest sciences, verification is rooted in validation. Verification is rooted in skill. The explicit is rooted in the tacit. And the whole is a comprehensive achievement.

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<sup>1</sup>Polanyi, Personal Knowledge, 202.



#### IV. BELIEF

Modern man is unprecedented; yet we must now go back to St. Augustine to restore the balance of our cognitive powers. In the fourth century A.D. St. Augustine brought the history of Greek philosophy to a close by inaugurating for the first time a post-critical philosophy. He taught that all knowledge was a gift of grace, for which we must strive under the guidance of antecedent belief: nisi credideritis, non intelligitis. His doctrine ruled the minds of Christian scholars for a thousand years. Then faith decoined and demonstrable knowledge gained superiority.<sup>1</sup>

For Polanyi all knowledge is rooted in belief (though he is not speaking of a supernatural faith like Augustine's). Just as knowledge is not able to be fully explicitated, neither is it able to be fully demonstrated. There always exists an ultimate range of beliefs, rooted in one's own activity, language, and culture, which found the demonstration of individual acts of knowing. These ultimate beliefs cannot themselves be demonstrated, but are accepted as the objects of a personally held commitment. Thus the ultimate reason one must give for holding any piece of knowledge is "because I believe it to be so." Polanyi feels that an adequate philosophy must acknowledge explicitly this fiduciary foundation of all knowledge, if it is

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<sup>1</sup>Ibid. 266.

going to avoid the danger of setting up a false ideal of knowledge.

Positivism is the prime example of a philosophy which has refused to acknowledge the fiduciary foundations of all-knowing. As a result there was erected the ideal of a completely detached, impersonal, and scientific objectivity. The desirable thing was to remove the subject as much as possible from knowledge, and thus achieve universal validity through a machine-like objectivity. Positivism conceives science, the only valid form of knowledge, as based on completely demonstrable fact:

The philosophy-to-end-all-philosophy may be designated, if somewhat loosely, as positivism. It continued in the nineteenth and twentieth centuries the rebellion against the authority of the Christian churches first started in the days of Montaigne, Bacon and Descartes. But the movement set out not only to liberate reason from enslavement by authority, but also to dispose of all traditionally guiding ideas, so far as they are not demonstrable by science...In this light, justice, morality, custom and law appear as mere sets of conventions, charged with emotional approval, which are the proper study of sociology. Conscience is identified with the fear of breaking socially approved conventions, and its investigation is assigned to psychology. Aesthetic values are related to an equilibrium of opposed impulses in the nervous system of the beholder.<sup>1</sup>

Under the guidance of such concepts one is expected to become truly detached and objective in approaching the whole world, including one's self and the affairs of men. Polanyi upholds the

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<sup>1</sup>Michael Polanyi, "The Nature of Scientific Convictions," *The Nineteenth Century*, CXLVI (July, 1949), 14.

fiduciary foundations of all knowing in opposition to this positivistic ideal of a completely demonstrable knowledge. The point of the present chapter will be to outline Polanyi's defense of belief and see how belief fits into the comprehensive structure of knowing.

### Different Systems of Belief:

There exist in the modern world a number of radically different systems or sets of belief. Polanyi would associate himself with the set of beliefs embodied in the Western tradition and in modern science. From this vantage point he sees a number of other systems of belief which in many instances contradict his own. Examples of such conflicting beliefs are those of Marxism, astrology, or the beliefs of current primitives in witch-craft, sorcery, and oracles. For the purposes of this chapter it will be preferable to narrow the examination and investigate the contrast between the beliefs of modern science (with which Polanyi associates himself) and those of the Zande Indians in oracles.

The Zande submit questions to the oracle, then administer a substance called "benge" to a specially chosen bird. The "benge" is administered in prescribed doses and accompanied by special incantations. By observing the condition of the bird, as it changes after being given the benge, the Zande are able to inter-

pret the message of the oracle. This whole ritual and the belief in its efficaciousness is embodied in the tradition of the Zande. This particular belief is part of a whole system of beliefs, and within that system has an imperceptible connection and influence among many other of their beliefs. All of these beliefs mutually support one another; and over the years the belief in the oracle, along with their other beliefs, have (at least to the satisfaction of the Zande) been confirmed by experience.

Modern science, of course, easily discovered that "benge" is a natural poison. When administered to a fowl in small doses it will perceptibly change his health, but usually will not kill him. Thus science believes the Zande to be mistaken in their belief in the oracle. Furthermore, they can point to tests which will falsify this belief by proving benge to be a natural poison. Such proof, however, does not interest the Zande. Polanyi makes reference to the findings of Evans-Pritchard in examining the Zande belief in oracles:

He often asked Azande what would happen if they were to administer oracle-poison (benge) to a fowl without delivering an address, or if they were to administer an extra portion of poison to a fowl which has recovered from the usual doses. The Zande -- he says -- does not know what would happen and is not interested in what would happen; no one has been fool enough to waste good oracle-poison in making such pointless experiments which only a European could imagine. Indeed, were a European to make a test which in his view proved Zande opinion wrong they would stand amazed

at the credulity of the European. If the fowl died they would simply say that it was not good benge, the very fact of the fowl dying being proof of this.<sup>1</sup>

This introduces the further point, not only is the Azande uninterested in performing experiments which might falsify his belief in the poison-oracle, but actually no experiment could be performed which would convince him of the falseness of the oracle. Any experimental evidence, seen from the Zande point of view, can be either explained away or ignored as negligible and irrelevant. This deserves elaboration.

Any objection to the Zande belief in the poison-oracle or any experimental evidence against it can be met one by one. If a large dose of poison is administered to the bird and it dies, the Zande must decide how to interpret this happening. If the Zande were facing this situation without any preconceptions, completely detached from any view of the world or system of beliefs, they might well suspect that the benge was a natural poison. However, the individual case of the death of this bird is seen against the background of their whole tradition and cultural belief in the oracle. This particular instance is seen in the context of the thousand of past instances which have been inter-

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<sup>1</sup>Michael Polanyi, "The Stability of Beliefs," The British Journal for the Philosophy of Science, III (November, 1952), 220-221.

preted in terms of their belief. In such a context, this individual instance can only be interpreted as a case of bad benge. The bird died, not because benge is a natural poison, but because the benge selected was not good benge. This instance is not seen as weakening belief in the oracle; rather, because the oracle is accepted as true and the benge accepted as an oracular substance and not poison, the death of the bird "proves" that the benge was not good benge. Not only would such an instance not weaken the Zande system of belief; but, on the contrary, by being interpreted in terms of that system it would constitute one more piece of evidence confirming the belief in the oracle.

Not only does the force of the traditional belief have the power to outweigh any objections which can be considered one-by-one; but the Zande will have alternative secondary explanations for any instances which seem to fall outside their belief in the oracle. One example of this was interpreting the above instance as a case of bad benge rather than interpreting benge as a natural poison. Other possible secondary explanations might be: "that the bird was sick before the benge was administered," or "that the rites had not been properly performed while administering the benge." Thus the Zande beliefs gradually grow into a well-knit and self-consistent system, more or less impregnable to the force

of evidence which would refute the system. Individuals living within such a cultural framework have little chance of setting themselves free from this set of beliefs. They are embodied in the language they speak and the interpretation of the world which has been taught them since childhood. Furthermore, from the time they begin to think, they think from within their language and their culture and in communication with other men who share their beliefs. Thus each day's thought and activity will serve to strengthen the "evidence" for these beliefs.

The crucial question must now be faced: "how is this phenomenon of the Zande beliefs to be interpreted?" This is not to ask whether the belief in poison-oracles is true or false. Even if this particular Zande belief is accepted as false, the question remains whether the whole process by which the Zande built up a system of beliefs and interpreted new instances from within that system of beliefs is basically valid or invalid. Positivism would suggest that the Zande have been led into error because they were careless. A man must approach new evidence with an "open mind." He must not allow his belief in a certain interpretation of the world "bias" him against the import of new evidence. Positivism would go on to claim that the success of science is precisely due to its ability to be "disinterested"

and "impersonal" in its approach to fact. Thus rather than "interpret fact in terms of its beliefs," it succeeds in "demonstrating" knowledge by observable "fact." Polanyi would, of course, disagree with this positivistic interpretation of science. Science may have developed a more accurate scientific skill; its conclusion that benge is a natural poison may be "true" and the Zande belief in oracles "false;" however, the triumph of science is not due to its willingness to be detached from belief or its refusal to interpret fact in terms of belief. At this point it will be helpful to examine Polanyi's attitude toward science more closely.

#### Science and Belief:

Science takes place in a community. The members of this community have been trained in the skills necessary to conduct research, appraise the value of problems, get new and relevant ideas, carry out experimental verifications, etc. This community, through a cooperative effort, gradually builds a body of commonly accepted theories. The body of theory not only applies to the limited areas in which it has been verified, but constitutes a network of belief in terms of which scientists interpret reality. New facts are seen in the light of current scientific beliefs. New problems form within these beliefs. These prob-



lems are appraised by the criterion of this current scientific opinion. Discoveries are made out of the background of this framework of belief. Finally, evidence for verification is found and interpreted in the light of these beliefs.

Thus the basic structure of knowledge working within the context of belief is present in science just as it was found to be present in the Zande beliefs in oracles. Science does not observe "pure fact" from a detached viewpoint any more than the Zande do. Scientists consider facts from within the framework of current scientific belief. From this standpoint, with its inherent bias, they decide whether facts are important and relevant, whether they are worth a closer study or are to be ignored. Polanyi outlines a few historical examples which bring out his point.

1) In June of 1947, Lord Rayleigh, a distinguished fellow of the Royal Society, published a paper (in Proceedings of the Royal Society) describing some simple experiments which proved in the author's opinion that a hydrogen atom impinging on a metal wire could transmit to it energies ranging up to 100 electronvolts. Polanyi points out that if such an observation were correct it would be of revolutionary importance. Yet when the paper came out scientists in general would not believe in the theory.

Though they could not explain the results, they did not think it worth while even to repeat the experiment. They simply ignored it. Since then Lord Rayleigh has died and the matter seems to have been completely forgotten. Polanyi attributes this neglect to the incompatibility of the proposed theory with current beliefs regarding the nature of atomic processes.<sup>1</sup>

Simultaneously with Rayleigh's paper, another paper was published by Professor P.M.S. Blackett. He pointed out a simple relationship which exists between angular momentum and stellar magnetism as applicable to the earth, the sun and a third star. This communication was meagre as compared with Rayleigh's. Nonetheless, it was received by scientists as an important discovery justifying further exploration.

Polanyi claims that thirty years earlier the reactions to these two papers would have been shrugged aside as just one more curious numerical coincidence. On the other hand, Lord Rayleigh's observation would have been accepted at face value, since it would not have stood in contradiction to accepted beliefs.<sup>2</sup>

2) Another example occurred in the early 1900's. Arrhenius had postulated a chemical equilibrium between the dissociated and

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<sup>1</sup>Polanyi, "The Nature of Scientific Convictions," 16.

<sup>2</sup>Ibid. 17.

the undissociated forms of an electrolyte in solution. From the very beginning the measurements showed that this equilibrium was true for weak electrolytes like acetic acid, but not for the prominent group of strong electrolytes, like common salt or sulphuric acid. For some 30 years these discrepancies were tabulated, yet no one thought of questioning the theory which they so flagrantly contradicted:

Scientists were satisfied with speaking of the "anomalies of strong electrolytes," without doubting for a moment that their behaviour was in fact governed by the law that they completely failed to obey. I can still remember my own amazement when, about 1919, I first heard the idea mooted that the anomalies were to be regarded as a refutation of the laws postulated by Arrhenius and to be explained by a different theory. Not until this alternative conception (based on the mutual electrostatic interaction of the ions) was successfully elaborated in detail, was the previous theory generally abandoned.<sup>1</sup>

Polanyi points out that contradictions to scientific theory are often disposed of by calling them "anomalies." These contradictions are thus explained away or ignored because they are considered unimportant or negligible. This process is similar to the way the Zande explain away contradictions to their belief in oracles. Such a procedure is not only a fact in science, but very often proves justified when "anomalies" are explained by a

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<sup>1</sup>Polanyi, "The Stability of Beliefs," 228.

subsequent re-interpretation of the original theory.<sup>1</sup>

3) Some years ago there appeared in Nature a table of figures proving with a great deal of accuracy that the time of gestation of a number of animals is a multiple of the number . However, an exact relationship of this kind makes no impression on the modern scientist, and no conceivable amount of further evidence would convince him of such a relationship. Polanyi points out that the rejection of such a relationship expresses a comparatively recent belief of science. He suggests that a scientist like Kepler would by no means have regarded it as absurd.<sup>2</sup>

4) Polanyi indicates that beliefs will be held in the face of strong contradictory evidence, even when the belief is still in a very hypothetical stage. The positivistic idea that a scientist drops a hypothesis the moment it conflicts with experience is pure myth. No true scientist would act in so clumsy a manner.

Niels Bohr did not drop his theory of spectra, which was confirmed only by one single type of atom -- that of hydrogen -- and broke down at the very next step, when applied

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<sup>1</sup>Ibid. 228-229.

<sup>2</sup>Michael Polanyi, "Scientific Beliefs," Ethics, LXI (October, 1950), 34.

to helim. The periodic system of elements could be fitted into it only in the reverse sequence of their atomic weights. Chemistry held on firmly to the cyclic formula of benzene proposed by Kekule in 1859, even though it became clear, as the years passed by, that the two different disubstituted derivatives which it postulated did not, in fact, exist. Scientists will often tolerate such contradictions to their theory, regarding them as anomalies.... The scientist's decision depends on the strength of the beliefs in the light of which he interprets his observations, and we approve of this decision if we share these beliefs.<sup>1</sup>

Thus Polanyi would conclude that all knowledge, whether it be carried on by a scientist or an Azande, takes place in a context of belief. Fact and evidence are interpreted in the light of belief. Discovery and verification are carried on in this context. Science can disagree with the Zande belief in oracles, but it cannot quarrel with the process by which the Zande build up a system of beliefs and carry on their activity of knowing within the framework of their beliefs. For science exhibits a similar process in its own knowing.

#### The A-Critical Nature of Belief:

The previous comparison of the beliefs of Zande and of Science has suggested that the process of knowing takes place always within a framework of belief. One does not attempt to pursue knowledge from a detached point of view; but he uses

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<sup>1</sup>Ibid. 29-30.

his language, his skills, his tradition, and the assistance of his community in attempting discovery, verification, demonstration or criticism. Since the critical movement in knowledge must itself be pursued from within such a framework of belief, the beliefs themselves stand outside that critical movement. Thus it follows that belief is looked upon as a-critical. This section will examine the a-critical nature of belief more closely.

The a-critical element comes out most clearly in the area of language. When one talks about the weather, he concentrates upon what he is saying about the weather. However, in speaking he is using a very complicated system of language which has been developed over the centuries, contains an implicit theory of the universe, and must be used according to certain rules. The speaker is not concentrating on any of these elements as he discourses about the weather. He does not consider the complicated system he is using nor the fact that it has been handed down to him from earlier generations. He does not think, at the moment, of its containing an implied view of the universe nor does he ask himself about the correctness of that interpretation of the universe. He does not reflect upon the fact that even the categories he is using to describe the weather have been given him by his language. He does not consciously consider the grammatical

rules which guide sentence structure nor the meanings of individual words, as he constructs sentences and uses words to speak of the weather. In all this he concentrates upon the weather and what he wishes to say about it, and everything else forms the framework of belief from within which he views the weather. In this instance the framework of belief is obviously used a-critically.

However, it is possible for one to reflect upon his own activity and speak precisely of the various elements that make up the framework of belief. One can speak of his language, of grammatical rules, of his own use of those rules. Furthermore, this reflection can be critical. That is, one can, after uttering a sentence, ask himself whether he used his language correctly in uttering the sentence. Or one could ask in reflection whether the language he used to describe a given situation was actually adequate to that situation. One might decide that it is necessary to find a new symbolic system to speak adequately of the situation. However, the very act of deciding that a new symbolism is required to handle a particular problem, will be done in terms of words and a language which form a framework of belief for this act. There is no end to the amount of critical reflection which can be attempted, nor is there any element in the

linguistic framework of belief which cannot be reflected upon critically; however, that very critical reflection must have its own framework of belief. It is impossible to step entirely outside of a framework of belief, to become completely detached. For the unfolding of the mind, even the most critical unfolding of the mind, requires a language in terms of which it unfolds, and this language forms a framework of belief.

So long as we use a certain language, all questions that we can ask will have to be formulated in it and will thereby confirm the theory of the universe which is implied in the vocabulary and structure of the language. It follows that we cannot state without self-contradiction within a language any doubt in respect to the theory implied by the language. The only way to dissent from the theory of the universe implied in a language is to abandon some of its vocabulary and to learn to speak a new language instead.<sup>1</sup>

A skill is similarly part of the a-critical framework of belief. Take the instance of the golfer. As he concentrates upon hitting the ball, he skilfully uses his muscles, sight, and touch -- and these form what could be called a framework of belief for his activity. Now even in an activity like golf there can be a type of critical reflection. One can discover that he is not holding his left arm straight or that he is taking his eye off the ball. In fact with the help of a good coach, the slightest detail can be brought to a person's attention. It may be pos-

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<sup>1</sup>Polanyi, "Stability of Beliefs," 221-222.



sible then for the golfer to work on this point, to give it more of his attention. Ultimately this correcting process will be somewhat artificial and he will eventually have to come to the point where these activities can be performed correctly without concentrating on them. However, even when he is concentrating on correcting one element of his skill, he must rely on the other elements taking care of themselves. They now form the framework of belief within which he attempts to correct one or another flaw in his skill. It is not possible for him to be critically aware of all the elements of his skill as he performs them. And even if it were conceivable to reflect critically upon all the elements of one skill, other skills would be put to use in the process -- skills of perception, reflection, and judgment -- and these skills would form the framework of belief for the critical activity. As in the case of language, it is impossible to step entirely outside the context of skill even when one is critically examining one's skill.

Basically, it must be acknowledged, that all unfolding of human activity and human knowing takes place within a framework of belief. The framework is used a-critically. Even critical activity must take place in such an a-critical framework. It is logically impossible to have a complete critical awareness of the

unfolding of one's own activity at the moment when the unfolding takes place. Such an attempt could only lead to the destruction of meaningfulness.

...The present moment's belief can be rejected or modified by the next moment's reflection, but this reflection, and its result, will be again an ultimate commitment, which so far cannot have yet become the object of reflection or criticism. But commitment must have duration. Any attempt to accompany it simultaneously by reflection is logically self-contradictory, and if we persist, it results in the disintegration of our person. If we cannot lose ourselves at all, but feel compelled to observe ourselves in all we do, we become disembodied in the manner which Sartre has penetratingly described....The result is not a superior degree of detachment, but an impotent nihilism.<sup>1</sup>

#### Belief and Comprehension:

It only remains to situate belief within the structure of "comprehension." All knowing and all activity are regulated by a tacit skill which integrated subsidiary elements in terms of a focus. Subsidiary elements are not known directly, in themselves; but they are interiorized and known in terms of a focal unity. By interiorizing subsidiary elements one "dwells within" them to know their focal integration. A person dwells primarily within his own body, to know things other than himself. And he dwells within his language and his tools, as extensions of his body, to attain more sophisticated knowledge and more skilful activity.

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<sup>1</sup>Polanyi, "The Nature of Scientific Convictions," 22.

The language of one's culture and the tools and other subsidiary elements which are interiorized in various knowing activities form a framework of beliefs. One dwells within these beliefs in interpreting the world, in choosing fruitful problems, in working toward a solution, in arriving at a discovery, or in the more critical type of reflection and verification. In all these activities the mind unfolds by integrating subsidiary elements. It unfolds in terms of language and skill. It unfolds by dwelling within certain elements in order to know their integration. It unfolds a-critically, from within its beliefs.

Thus the subsidiary framework, from within which one attempts to know, constitutes always a framework of belief. This framework of belief is a-critical because it is known subsidiarily and integrated tacitly. The framework of belief is fundamental to all knowing, for all knowing is achieved by dwelling within subsidiary elements and all knowing proceeds by integrating these subsidiary elements tacitly. The idea of a completely detached knowledge would be one which did not integrate subsidiary elements, which had no subsidiary framework, no interiorization, no indwelling. If it is true that all knowing is comprehensive in structure, then it is equally true that all knowledge is founded in belief, and there is no such thing as a completely detached and impersonal objectivity.

## V. COMPREHENSION AND THE MODERN AGE.

The first four chapters of this paper have examined the nature of comprehension, its structure, its fundamentally a-critical character, the limits of the critical element, and the various types of knowing that are integrated into it. This final chapter will attempt to examine Polanyi's idea of comprehension in relation to one of the major problems of the age, namely the tendency toward nihilism. There are two general areas where this nihilistic tendency has been most evident: 1) religion and morality, where doubt is cast upon traditional values and beliefs; 2) the arts and social sciences whose meaning is destroyed by an overly strict imposition of the methodology and ideals of the physical sciences.

1) There has grown up in the age since the scientific revolution a conflict between science and religion. If one were to look for an historical symbol it might well be found in the Galileo incident; however, the conflict runs much deeper than any incidents that can be pointed to. Polanyi points out that it has been a conflict of authority. "In medieval times you could shatter an opinion on the grounds that it was contrary to religion,

just as today you can do so by showing that it is contrary to science. The reason is obviously that the authority of religion has been impaired by the principle of doubt, while that of science has been rather increased by it."<sup>1</sup>

This "principle of doubt" Polanyi links with a critical and mechanistic movement which he traces all the way back to the Greeks.<sup>2</sup> This movement has appeared in many forms over the centuries, but its basic principles can be stated briefly: It claims to accept only such beliefs as are founded on reason and experience. It seeks to eliminate error by the vigilant searchlight of doubt. And finally it is passionately hostile to uncritically held beliefs, which it regards as sources of superstition and fanaticism.<sup>3</sup>

Thus it is not science itself which is fundamentally responsible for the deposition of religion's authority, but rather this critical movement which has somehow been identified with science in the present age. Science is held to be the outcome and supreme justification of this critical method, and thus there is the tend-

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<sup>1</sup>Michael Polanyi, "Science and Faith," Question, 5 (Winter, 1952), 23.

<sup>2</sup>Ibid. 18.

<sup>3</sup>Ibid.

ency to measure the validity of all other knowledge and belief by its conformity or lack of conformity with the methodology of the physical sciences.

The shadow of doubt which first passed over religion has also passed over the realm of philosophy and thus has undermined the claims of morality.

When the modern positivist says of a statement that it is metaphysical he means that it is nonsense. For the past fifty years it has been hammered into us with ever increasing vigour that science is concerned only with verifiable statements and must be purified of all other elements, which are mere metaphysics. Viennese school of philosophy has generalized this principle into a universal critique of human utterances. It points out for example that if you say that it is wrong to bear false witness, you find that you have made a statement which cannot be proved by the facts. No chemical analysis or microscopic examination can prove that a man who bears false witness is immoral. Hence to call him immoral is either meaningless or no more than an exclamation of disgust, such as one may utter when biting at a worm inside an apple.<sup>1</sup>

2) This critical movement and the tendency toward nihilism which is beginning to emerge from it has also penetrated the realms of the social sciences and art. If an historian is lauded on the grounds that his work is truly scientific, this will be accepted as a relevant term of praise. The historian will thus strive to be scientific. An educator, criticized on the grounds that his method is unscientific will consider this a dispa-

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<sup>1</sup>Ibid. 24.

ment. Often students of man will make desperate efforts to appear scientific, and some psychologists have turned away from the study of consciousness in order to become truly scientific. The economist is constantly worried about doubts as to whether economics is really a science. The usual way of dealing with this problem is to claim that these are still "young" sciences. The implication is that as they mature they will come to resemble physics more and more. Physics is thus acknowledged as the only truly exact science, one which is strictly verifiable.<sup>1</sup>

Modern art and music have felt the touch of the nihilistic destruction of meaning. Both have arisen rebelliously as a deliberate rejection of socially accepted standards. This age has become so used to the spectacle that its uniqueness is seldom averted to. Great artists of other ages have often gone unrecognized in their lifetime; however, never before has a whole artistic culture gone on flowering through successive generations in systematic opposition. It is Polanyi's contention that they cannot move indefinitely in this direction.

Modern art has arisen from a persistently continued destruction of existing artistic realities for the sake of penetrating to strata of harder, more genuine forms of reality. So the "poetic" has vanished from our poetry, the "picturesque" from our painting, the "harmonious" from our

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<sup>1</sup>Ibid. 25.

music, the heroes and heroines from our novels and plays. All these were rejected in the pursuit of a harsher artistic truth. But can this process go on indefinitely? Must it not presently lead to a complete destruction of meaning?<sup>1</sup>

This then is Polanyi's analysis of the central problem of the age. The critical movement, which has been productive of so much good, is threatening now to lead to nihilism and the destruction of reality:

The critical imperative of rejecting any belief that can quite conceivably be doubted has become second nature with us. To assert any belief uncritically as a matter of our faith has come to be regarded as an offense against reason. We feel in it the menace of obscurantism and of an authoritarian restriction of free thought. Belief in science is the only belief left which we still feel entitled to hold on these grounds. So we are compelled to transpose all the rest of our beliefs into scientific teachings and where this proves impossible we try at least to dress them up as teachings of science.<sup>2</sup>

It is possible to translate this crisis of the age into terms of "comprehension." Fundamentally, the critical movement has not realized that all knowledge is comprehensive in character and thus is always rooted in subsidiary "beliefs." It has not apprehended that knowledge is a tacit activity of integration. Ideas like tacit and subsidiary knowing are something of a scandal to it. It wants everything to be verifiable in the sense

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<sup>1</sup>Polanyi, "History and Hope," 15-16.

<sup>2</sup>Polanyi, "Science and Faith," 30.



that the evidence for any position is explicit and focal.

What is needed is a conceptual renewal which grasps knowledge as an act of comprehension, rooted in tacit and subsidiary knowing. The critical element must be seen as itself an act of comprehension, and thus in principle always limited in effectiveness, always incomplete, always capable, in excess, of leading to the destruction of meaning.

What we have to do now seems to me quite obvious. We must get rid of the obsession which forbids us to believe anything that we could conceivably doubt. The critical movement which we inherited from Greece has brought us immeasurable benefit through the past centuries. It was the battle-axe of intellectual honesty, of free thought and of independent personality. But the benefits of this movement are nearing exhaustion while its dangers are growing fast. In the West it has forced us into an intellectual masquerade, a pretense of a scientific justification of our beliefs, which weakens and debauches them. In the East it has reached its logical terminus in a combination of nihilist theory and fanatical action.<sup>1</sup>

#### The Vindication of Reality:

The first half of this chapter has examined the age's tendency toward nihilism, toward the destruction of meaning, and thus toward the destruction of reality. It has so exalted physical science that it has reduced all other reality to the level of physical reality. Everything can be explained in terms of atomic

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<sup>1</sup>Ibid. 34-35.

theory, and anything that cannot is not real. Thus man is a physical and chemical reality. To speak of him as a conscious being, a moral being, or a religious being is to be mystical or metaphorical, it is not to speak of reality.

The second half of the chapter will go on to show how Polanyi, in affirming knowledge as comprehension, vindicates a reality of various levels -- physics, engineering, biology, psychology, morality, religion. The difference between physics and engineering, and the levels of reality with which they deal, will be explained as an instance of how the theory of comprehension leads to a vindication of a many-leveled reality.

It is Polanyi's contention that scientific analysis and the critical movement destroy higher levels of reality by reducing them to their focal particulars. The higher levels consist of comprehensive entities which can only be grasped by taking the particulars of lower levels subsidiarily in comprehending the higher levels. An instance on taking the particulars of a lower level focally makes it impossible to grasp the comprehensive realities of a higher level.

My vindication of reality will consist in showing that the universe is in fact such that my conception of knowing is appropriate to it; that there do in fact exist higher levels of reality composed by comprehensive entities, which include principles that are absent in the lower levels of reality composed of the kind of particulars which contrib-

ute to the comprehensive entities. This is why, by relying on our awareness of the particulars situated on a lower level of reality, we can apprehend the comprehensive entities on a higher level of reality, but cease to see these if we desist from using our powers of comprehension and look instead at the particulars in themselves. We shall vindicate reality by repudiating the obsession of scientific rationalism with tangible particulars which leads to absurdities.<sup>1</sup>

Take the instance of a machine (the object of the science of engineering), for example, a typewriter, car, watch or clock. A machine is defined in terms of its operational principles. These principles state the purpose of machine -- the function of its parts as they interact to achieve some purpose. If a machine is a reality, it is a reality which must be defined in terms of its operational principles.

If you have an idea for a new machine you will define it in the terms of its operational principles and you may claim a patent founded on this description of it. In applying for a patent you will carefully avoid any reference to material of which you have made such a machine, or think it would be best made; for if you do this, your patent could be circumvented by a competitor making your machine from some other material. You would, in fact, have failed to define in all its generality the class of objects comprised by the conception of your machine.<sup>2</sup>

If one were to consider the parts of a machine in themselves, as inanimate objects of the science of physics, he could

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<sup>1</sup>Polanyi, "History and Hope," 48-49.

<sup>2</sup>Ibid. 50.

never arrive at the operational principles of the machine. Take a machine apart and allow a team of physicists to examine its parts in great detail in terms of their science of physics. They will never be able to tell in terms of physics whether the object is a machine, and if so, what purpose it serves and how. Thus they will never grasp the operational principles which define the machine. The particulars, which they are taking focally to comprehend the atomic structures of these objects, must be grasped subsidiarily to comprehend the operational principles of the machine.

The operational principles define a machine in terms of its purpose. Thus in terms of the operational principles one can decide when a machine has failed to achieve its purpose. However, the operational principles themselves cannot explain the cause of the failure to achieve its purpose. This must be discovered on a lower level.

To understand these failures of a machine we must descend to an enquiry on the lower level formed by the parts of the machine, as mere inanimate bodies. In other words, we must call in physics and chemistry and examine the parts by the methods of these sciences. But this must be a peculiar kind of physics and chemistry: a use of physics and chemistry expressly bearing on the operational principles of the machine. In this ancillary role, which is called Applied Physics and Chemistry, these sciences can supply the information necessarily ignored by the operational principles of a machine. This is how engineers use physical and chemical investigations for establishing optimal conditions for the

construction and working of a machine and for learning to avoid its breakdown.<sup>1</sup>

Thus two different branches of science refer to these two levels within a machine. Engineering studies the machine as a machine, that is in terms of its operational principles. Pure physics might study the parts of the machine, but this study would have no relation to the machine as a machine. An applied physics can study the parts of the machine in relation to its operational principles, in the sense that it studies the optimal conditions for the working of those principles.

Thus a machine can only be known by relying on the subsidiary awareness of its particulars to grasp comprehensively its operational principles. To refuse to attempt this act of comprehension, to approach a machine analytically and critically, attending focally to its more tangible particulars, is to fail to grasp this higher level of reality. To vindicate the various levels of reality from physics to religion, one must uphold tacit and subsidiary knowing, as well as explicit and focal knowing. One must give to each of these its proper place within the integral structure of comprehension. By doing this Polanyi enables the age once again to affirm the full richness of a multileveled

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<sup>1</sup>Ibid. 52.

reality along with the intellectual and cultural values which are part of its tradition.

Modern man is unprecedented; yet we must now go back to St. Augustine to restore the balance of our cognitive powers. In the fourth century A.D. St. Augustine brought the history of Greek philosophy to close by inaugurating for the first time a post-critical philosophy. He taught that all knowledge was a gift of grace, for which we must strive under the guidance of antecedent belief: Nisi Credideritis, Non Intelligitis. .....We must now recognize belief once more as the source of all knowledge. Tacit assent and intellectual passions, the sharing of an idiom and of a cultural heritage, affiliation to a like-minded community: such are the impulses which shape our vision of the nature of things on which we rely for our mastery of things. No intelligence, however critical or original, can operate outside such a fiduciary framework.<sup>1</sup>

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<sup>1</sup>Polanyi, Personal Knowledge, 266.

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The thesis submitted by **Richard W. Zipfel, S.J.,**

has been read and approved by three members of the Department of  
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The final copies have been examined by the director of the  
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The thesis is therefore accepted in partial fulfillment of  
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